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ORCHESTIA VAGGALA, A NEW LAND-HOPPER FROM THE GALÁPAGOS ISLANDS (CRUSTACEA: AMPHIPODA: TALITRIDAE)

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During his recent intensive collecting of land snails throughout the Galápagos Islands, Dr. Joseph Vagvolgyi found a few terrestrial amphipods at three localities at San Cristóbal Island. He kindly turned them over to me for study, and I found them to represent a species new to science which is described below.

Orchestia vaggala, new species
Figs. 1–4

Material examined.—San Cristóbal I. (= Chatham I.), Galápagos Is., S Slope of El Junco Peak, near Chino, leg. Joseph Vagvolgyi, Feb. 1974.—Sta. 101, 4 Feb.: 9.4 mm ♂ (holotype, USNM 169045); 11.2 mm ♀, oostegites with marginal setae; 9.3 mm ovig. ♀; 9.3 mm ♀, oostegites without setae.—Sta. 103, 4 Feb.: 9.7 mm ovig. ♀; 9.5 mm non-ovig. ♀.—Sta. 105, 5 and 7 Feb.: 8.1 mm ♀, oostegites with setae; 8.3 mm ♀, oostegites without setae; 9.1 mm ♀, oostegites without setae. The ♀♀ listed above are paratypes, USNM 169046 (Sta. 101); USNM 169047 (Sta. 103); USNM 169048 (Sta. 105).

Etymology.—A combination of contractions of *Vag*volgyi, the collector, plus *Gala*pagos, the locality.

Description.—Length (head–telson) 8.1–11.1 mm. Eyes black, nearly round, diameter almost 0.4 length of head; separated dorsally by about 0.4 eye diameter. Antenna 1: Not reaching distal margin of antenna 2 peduncle; segments of peduncle subequal in length; flagellum 3–4-segmented. Antenna 2: Reaching posterior margin of pereonite 3 to pereonite 5; segment 4 of peduncle about 0.7 length of segment 5; flagellum 14–18-segmented.

Mandible: Incisor of left mandible 6-cuspate, of right 5-cuspate; left lacinia with 4 rounded cusps, right lacinia with 3 cusps, more pointed; right spine-row with 6 spines, left with 4; molar with usual transverse rugae on chewing surface, a single guide seta dorsally, and ventrally a flap armed apically with plumose setae. Maxilla 1: As in other species of *Orchestia*; outer lobe with 9 dentate apical spines; inner lobe with 2 plumose apical setae. Maxilla 2: As in Fig. 1*F*. Maxilliped: Inner lobe with 3 stout spines and numerous plumose setae on distal margin; palp 3-segmented, 3rd segment with minute process apparently representing rudimentary 4th segment.

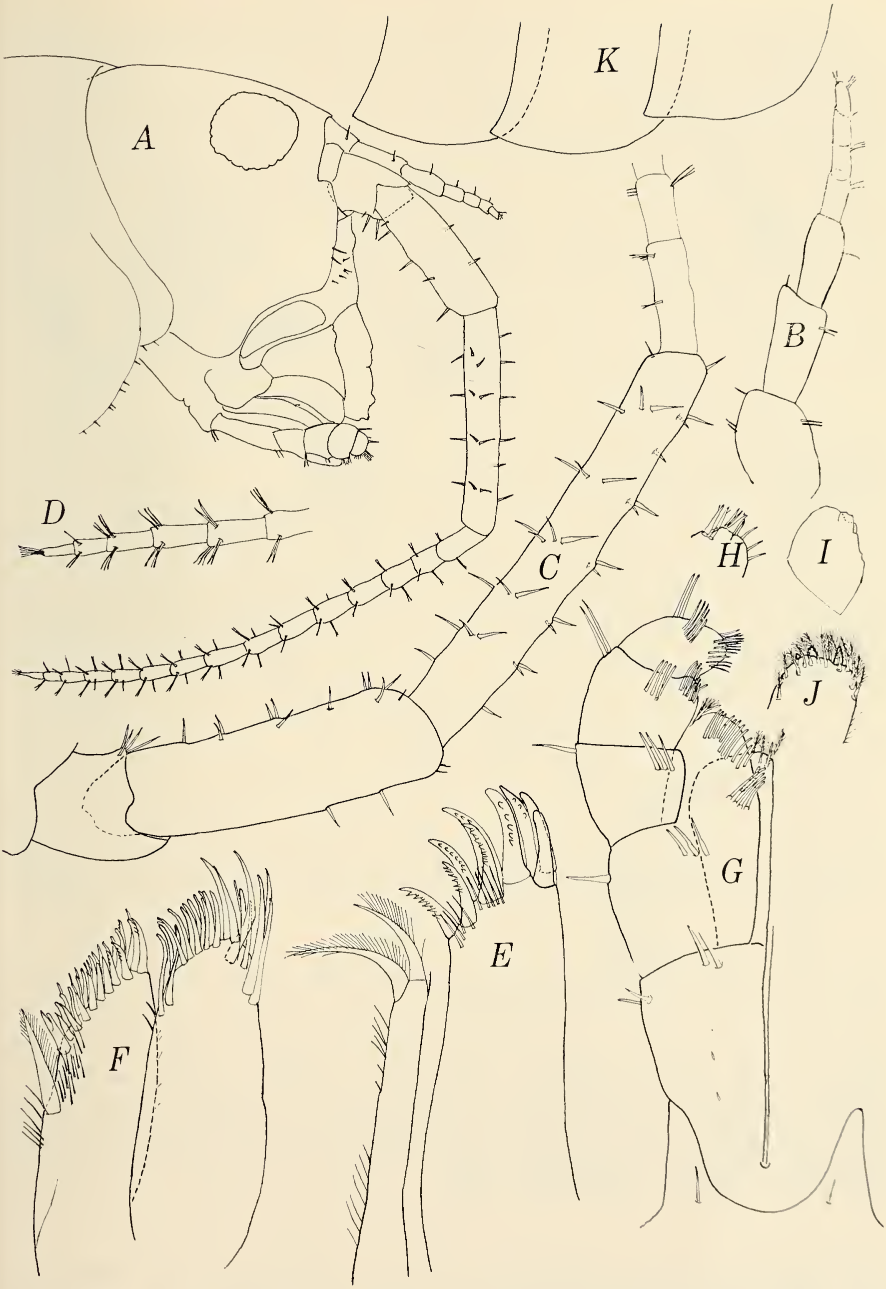

Fig. 1. *Orchestia vaggala.* *A*, ♀ head, lateral; *B*, ♂ right antenna 1; *C*, ♂ left antenna 2, proximal segments; *D*, Same, distal segments; *E*, ♀ maxilla 1; *F*, ♀ maxilla 2; *G*, ♀ maxilliped; *H–I*, Same, apex of palp with and without setae; *J*, Same, apex of inner lobe; *K*, Pleonal epimera.

Fig. 2. *A–K, Orchestia vaggala. A–E,* ♀ left mandible: *A,* Entire mandible; *B,* Incisor; *C–D,* Incisor and lacinia, from different aspects; *E,* Spine-row. *F–G,* ♀ right mandible; *F,* Incisor, lacina, and spine-row; *G,* Incisor. *H,* ♀ left pereopod 1; *I,* Same, dactyl and distal part of propus; *J,* Same, dactyl; *K,* ♂ pereopod 1. *L. Orchestia costaricana,* ♂ syntype: pereopod 7, basis.

Pereopod 1: Nearly identical in ♂ and ♀, with only minor differences in setation. Posterior pellucid process of merus small, that of carpus larger; propus widening slightly distally, palm nearly vertical, slightly convex posteriorly, overlapped by 2 groups of submarginal spines; dactyl armed as

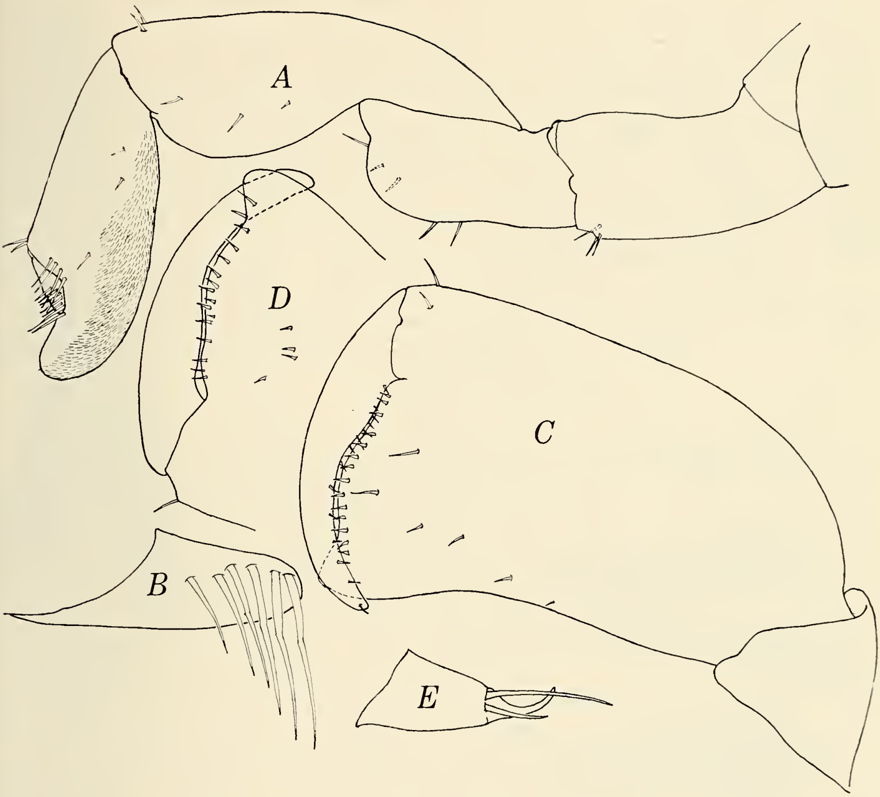

Fig. 3. *A–D, Orchestia vaggala. A,* ♀ pereopod 2; *B,* Same, dactyl; *C,* ♂ pereopod 2, lateral; *D,* Same, medial. *E, Orchestia costaricana,* ♀ syntype: pereopod 2 dactyl.

in Fig. 2*J*. ♀ Pereopod 2: Propus widening only slightly distally, extending beyond dactyl by length of latter; palm with 4 submarginal spines overlapping dactyl; dactyl thumb-shaped, lateral surface with row of spines increasing in length distally. ♂ Pereopod 2: Propus about twice as long as wide, with slightly concave posterior margin; palm transverse, slightly convex, produced into bluntly triangular distal process overlapping tip of dactyl medially, armed with row of short submarginal setae on medial and lateral surfaces; dactyl evenly curved, extending slightly beyond palm, posterior margin slightly convex proximally.

Pereopods 3 and 4: Slender; dactyl moderately long, nail and proximal part subequal in length. Pereopod 4 of one ♀ appeared abnormal, with short carpus and dactyl (Fig. 4*C, D*). Pereopods 5 and 6: Similar, but pereopod 5 much shorter. Pereopod 7: Posterior expansion of basis with a

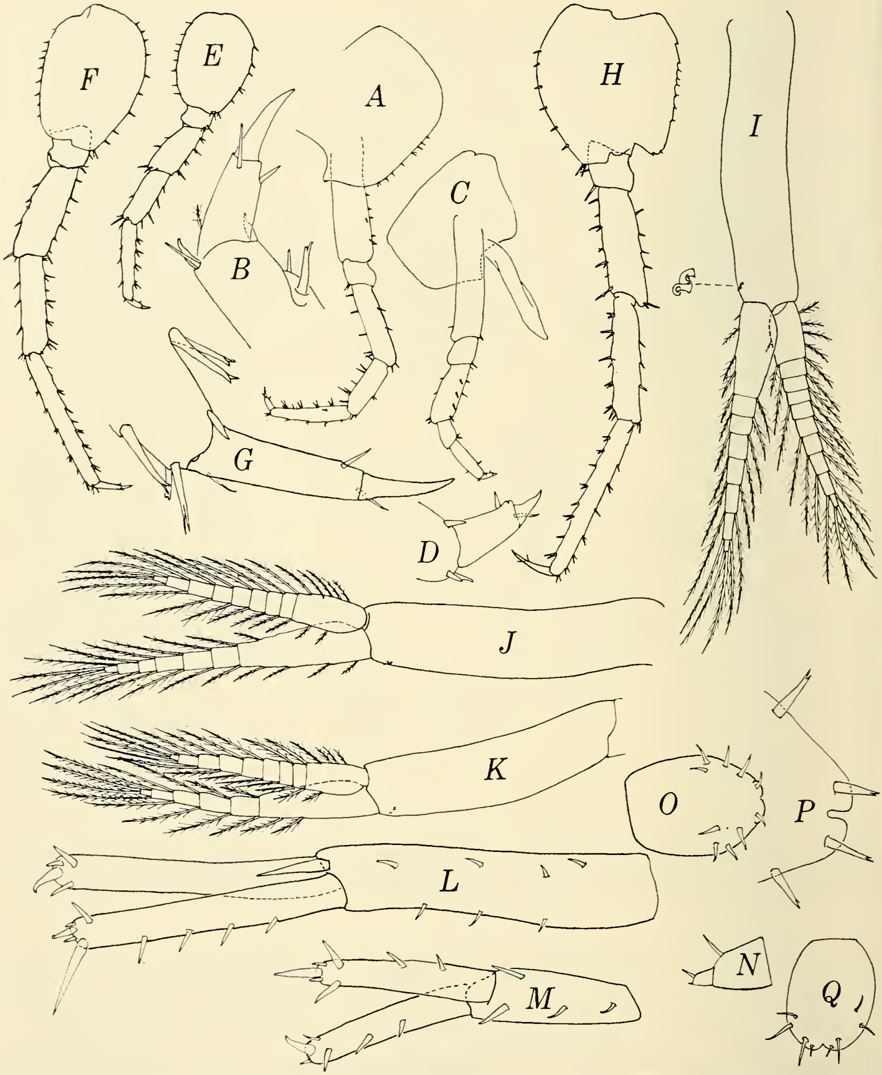

Fig. 4. *A–P*, *Orchestia vaggala*, ♀. *A*, Pereopod 3, lateral; *B*, Same, distal end; *C*, pereopod 4; *D*, Same, distal end, showing abnormal dactyl; *E*, Pereopod 5; *F*, Pereopod 6; *G*, Same, distal end; *H*, Pereopod 7; *I*, Pleopod 1, posterior; *J*, Pleopod 2, anterior; *K*, Pleopod 3, anterior; *L–N*, Uropods 1–3, dorsal; *O*, Telson, dorsal; *P*, Same, apex. *Q*, *Orchestia costaricana*, ♂ syntype: Telson, dorsal.

few weak serrations on margin; posteroproximal corner not reaching proximal margin of ischium.

Marginal setae of oostegites not curl-tipped.

Pleonal epimera: Margins unarmed; posteroventral corners angular.

Pleopods: Well developed; peduncles with 2 retinaculae; rami 6–10-segmented.

Uropod 1: Peduncle ⅕ longer than rami, with 2 dorsal rows of 3–4 spines and well developed interramal spine; outer ramus with unarmed margins and 4 spines near apex; inner ramus with 4 spines on medial margin and 5 spines near apex, medial apical spine very large. Uropod 2: Peduncle with 4 dorsal spines; each ramus with 2 marginal spines; outer ramus with 4, inner ramus with 5 spines near apex. Uropod 3, peduncle 2.5 times as long and much broader than ramus, with long distolateral spine; ramus with longer lateral spine and minute medial spine on distal margin.

Telson suboval, ⅓ longer than wide; apex with short rounded notch; dorsal surface with 10 bifid spines arranged as in Fig. 4O.

Relationships

Hurley (1957, 1959, 1968) and others have distinguished between "leaf-mold" talitrids or "land-hoppers," inhabitants of the forest floor or grasslands, and supralittoral talitrids or "beach-hoppers" and "rock-hoppers," which live on seashores from low tide level to the spray zone (and sometimes above). Following Stebbing's (1906a) separation of *Parorchestia* from *Orchestia*, there was a tendency to assign land-hoppers to *Parorchestia* and beach-hoppers to *Orchestia*. The validity of *Parorchestia* has been somewhat insecure, and many authors have treated it as a synonym of *Orchestia* (e.g. Shoemaker, 1942; Hurley, 1957; 1959; 1968; Barnard, 1958; 1969). In recent years Bousfield (1964; 1971; 1976) has recommended that *Parorchestia* be recognized as valid and restricted to species of the *tenuis*-type. He has predicted that new genera will be needed eventually for some land-hoppers now assigned to *Orchestia* but which differ widely from the type-species, *O. gammarellus*.

The genus *Orchestia* s.l. (i.e., including *Parorchestia*), is very large, comprising more than 100 nominal species. I have not compared *O. vaggala* with all the known species, but have assumed that the beach-hoppers, which occupy quite a different habitat and must have very different physiological requirements, can be all safely excluded from consideration. There remain about 40 species of land-hoppers, now assigned to *Orchestia* and *Parorchestia*. The species of *Parorchestia* can be eliminated because *O. vaggala* lacks the 4th segment of the maxilliped palp and has normal rather than curl-tipped oostegite setae. Most of the remaining species of *Orchestia* differ from *O. vaggala* by one of the following: 1. Lack of an interramal spine on uropod 1 (about 9 species, mostly in the *O. floresiana* group); 2. Presence of spines on margins of outer ramus of uropod 1 (e.g. *kaalensis*, *luzonensis*, *notabilis*); 3. One or more pleopods reduced to stumps (e.g. *lesliensis*, *patersoni*, *rubroannulata*). The few species still not eliminated differ in the shape and armature of the telson and/or pereopods 1 and 2 of one or both sexes.

O. vaggala does not appear to be closely related to any of the known species of *Orchestia*. A possible candidate for the closest relative is *O. costaricana* Stebbing (1960b), known from the mouth of Rio Jesus Maria, Costa Rica, which drains into the Gulf of Nicoya, Puerto Rico (Shoemaker, 1935), and Santa Cruz I. and Isabela I. in the Galápagos (Monod, 1970). In Costa Rica it was found "in mangroves in the mud under trunks of trees"; in the Galápagos it was collected 1–4 km inland, in soil and crevices. The habitat of the Puerto Rican specimens is unknown. At first glance *O. costaricana* appears to be far removed from *O. vaggala*, especially because of its chelate male pereopod 2, but also because of its barely subchelate female pereopod 1 and more sparsely setose maxilliped. On the other hand, there are impressive similarities in other characters traditionally considered to be important in the taxonomy of *Orchestia*: the male pereopod 1, the basis of pereopod 7 (compare Figs. 2*L* and 4*H*), the uropods, and the telson (Fig. 4*O*, *Q*).

Further speculation on the relationships of *O. vaggala* will not be attempted, since many land-hopper species on Pacific Islands await discovery (Bousfield, 1964; 1971; 1976) and since endemic, undescribed land-hoppers occur on Jamaica, Haiti, and Barro Colorado Island, Panama (Hurley, 1968).

Habitat

San Cristóbal is the easternmost and the fifth largest of the Galápagos Islands, having a surface area of 558 km^2 and a maximum elevation of 730 m. A prominent feature is the crater on the southern part of the island that contains a permanent freshwater lake, El Junco. This lake lies at an elevation of about 700 m and covers most of the floor of the crater (maximum diameter 290 m) with 6 m of water, a depth established by a low point in the crater rim where the lake overflows (Colinvaux, 1968). Water from El Junco and probably from underground sources also feeds intermittent streams on the south slope of the peak, as well as the only permanent stream on the archipelago, which empties into Bahía de Aquadulce (Freshwater Bay) on the southern coast. Precipitation varies greatly from year to year (Fig. 5), but in general there is a wetter season from December to May and a drier season from June to December. During the latter, a fine mist covers the heights, and although it does not fall as rain, it thoroughly wets the vegetation (Thornton, 1971).

It is evident, therefore, that the southern slope of El Junco peak provides enough soil moisture for the needs of land-hoppers. It is probably not just by chance that although Dr. Vagvolgyi collected land snails at many localities throughout the Galápagos Islands, he encountered land-hoppers only on San Cristóbal.

Collection data for the 3 sites where *Orchestia vaggala* was found is as follows:

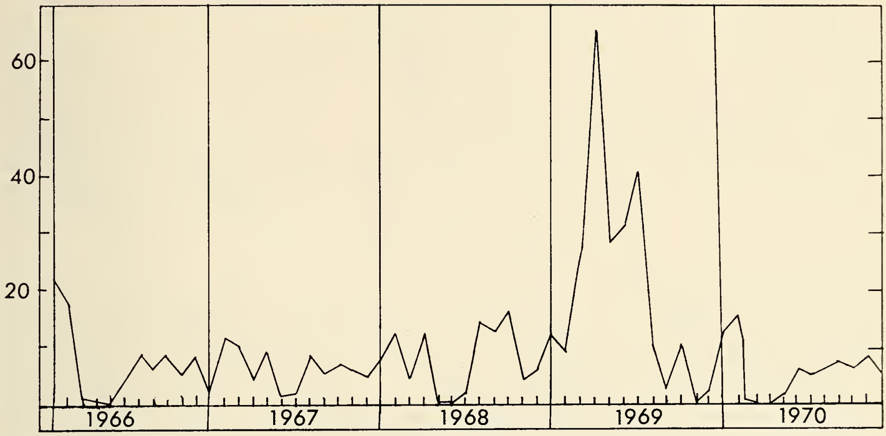

Fig. 5. Precipitation (mm) at El Progreso, San Cristóbal I. (west of El Junco peak), 1966–1970. Redrawn from Comisión Interinstitucional etc. (1973).

Sta. 101. Elevation 555 m. *Miconia*-zone. Collections made on bottom and sides of a wash, both from the litter and from arboreal mosspads; amphipods found only on the ground. In the wash was a dense growth of *Miconia robinsoniana* bearing many epiphytes: mosses, lichens, liverworts, and ferns. Ferns were also growing on the ground, and there was an occasional guava tree (*Pisidium guajava*). The ground was covered with brown soil with an occasional rock.

Sta. 103. Elevation less than 450 m. Probably in *Miconia*-zone, but possibly in moist forest zone. In same wash as Sta. 101 but farther downstream.

Sta. 105. Elevation between 550 and 600 m. Fern-sedge zone. Collections made at base of clumps of ferns (*Pteridium aquilinum*), grasses, and sedges. Trees absent but tree-fern *Cyathea weatherbyana* was growing in washes or steep areas. The ground was covered with soil; rocks were present only in the washes or on the steepest walls.

Origin

Five possible explanations for the occurrence of *O. vaggala* on San Cristóbal I. merit discussion.

1. *O. vaggala* developed locally from an unknown beach-hopper. Dr. J. L. Barnard kindly allowed me to search his Galápagos collections for talitrids. None of the beach-hoppers that I found were species of *Orchestia*, hence a Galápagos beach-hopper similar to *O. vaggala*, if it exists, remains to be found. Bousfield (1968) suggested that the less specialized land hoppers (which would include *O. vaggala*) evolved directly from seashore

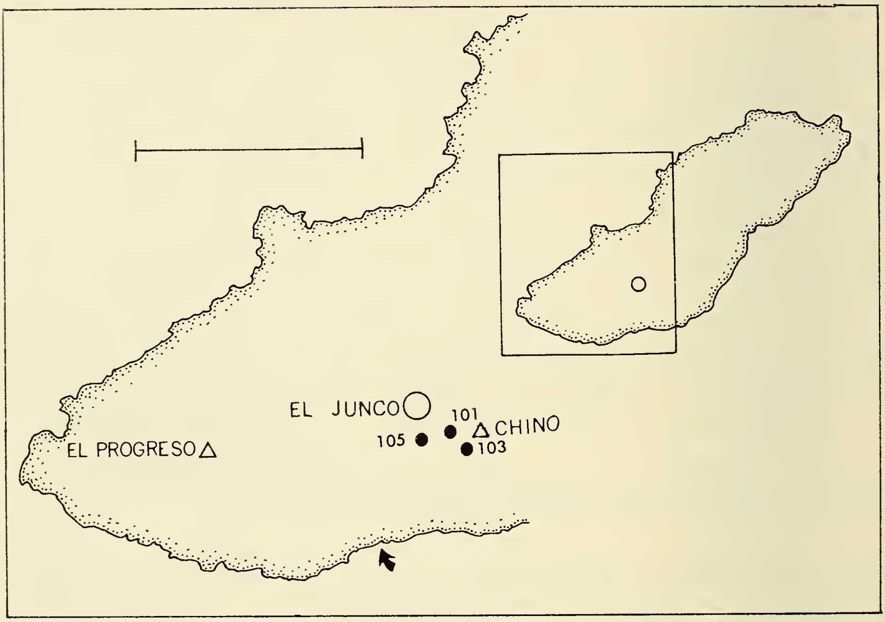

Fig. 6. San Cristóbal I., showing collection stations (solid circles) and other localities mentioned in text. Arrow points to Bahía de Aquadulce. Scale = 5 nautical miles.

species, whereas the more modified species "most likely originated in contiguous continental land masses centering on Antarctica, probably sometime during the Mesozoic . . . ."

2. *O. vaggala* was brought to San Cristóbal I. on vegetation introduced by man.

3. *O. vaggala* was carried to San Cristóbal I. on a raft of drifting vegetation. Thornton (1971) discusses the possibility of such rafts reaching the Galápagos from Peru and Ecuador with the Humboldt Current or from Panama with the South Equatorial Current.

4. *O. vaggala* was transported to San Cristóbal by birds. Observations and experiments by Segerstråle (1954) support the possibility of dispersal on ducks of *Gammarus lacustris*, but not *G. pulex*. Transport of *Hyalella azteca* by mallard ducks is documented by Rosine (1960). The possibility that *O. vaggala* was carried to San Cristóbal I. by birds seems unlikely, considering the distance involved, but cannot be dismissed outright. Some support for the possibility is given by the fact that numerous waterfowl, including ducks and curlews, live in El Junco.

5. *O. vaggala* migrated from western South America to the coastal "ancestral Galápagos Is." and dispersed gradually along island stepping stones

as easterly components of the archipelago subsided and more westerly islands emerged (Holden and Dietz, 1972; Rosen, 1975). This view of the history of the Galápagos contrasts with the view that these islands, about 1 million years old, are truly oceanic and have never been connected to or in proximity to a continental land mass. It also allows much more time, up to 40 million years, for the evolution of endemic species on the ancestral and modern Galápagos Is.

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